5. Complete extirpation of the cyst is by far the most satisfactory method of treatment, although in Boyer's time he considered it impossible. Difficulty has often been experienced in dissecting out the entire sac. Weir's method is an excellent one. He injected the sac with melted paraffin, and allowed it to harden before attempting to dissect out the sac. This method allows the cyst to be shelled out entire.

The writer wishes to acknowledge his indebtedness to E. H. Hayward, who prepared the histological sections at the Detroit Clinical Laboratory.

BIBLIOGRAPHY.

1. Boyer. Traité des Maladies chirurgicales, 1831.
2. Malgaigne. Anat. Chir., 1838, t. ii p. 40.
3. Verneuil. Archives générales de médecine, 1853, vol. i. pp. 185 and 450.
4. Batut. Étude sur l'hygroma de la bourse thyrohyoidieme et sou traitément. Bordeaux, 1886.
5. Beclard. Emmert's Lehrbuch der Chirurgie, Stuttgart, 1854.
6. Luschka. Die Anatomie des Menschen, Tübingen, 1862.
7. Grüber. Archiv f. Anat. u. Physiol., Leipzig, 1875, p. 590.
8. His. Anatomie menschlicher Embryonen.
9. Butlin and Spencer. Diseases of the Tongue, 1900, p. 4.
10. Schäfer. Quain's Anatomy, 1891, part ii., vol. i p. 393
11. Dressel. Beitrag zur Geschichte der Fistula Bursae Subhyoideae, 1888.
12. Friedlowsky. Allgemeine Wiener med. Zeitung, 1868. No. 22.
13. Wier. New York Medical Journal, vol. lv. p. 285.
14. London Lancet, November 23, 1889, p. 1058.
15. Ingalls. Medical News, February 13, 1897.
16 Hamilton. Medical Record, 1869–70, p. 545.

HÆMOLYMPH NODES.[1]

By Hughes Dayton, M.D.,

ALUMNI FELLOW IN PATHOLOGY, COLLEGE OF PHYSICIANS AND SURGEONS, COLUMBIA UNIVERSITY.

THE earliest mention of the occurrence of nodes macroscopically resembling the spleen was that of Leydig, in 1857, who described their occurrence along the abdominal aorta. Since 1875 the presence of lymph nodes of a red color or containing red blood cells has been noted by a number of observers, and various explanations have been offered to interpret these findings. To Warthin, of the University of Michigan, we are indebted for the most systematic and extensive study of these structures, and in his recent articles are contained the most convincing proof of the existence of the so-called hæmolymph node as an organ *sui generis*.

It is not the purpose of the writer to review exhaustively the work of others in this field, or to describe in detail the histology of these nodes, but rather to present the results of a personal study of their individuality and functions. A summary of the work of others in this field had been prepared, but the literature has since been so satisfactorily abstracted by Warthin in his most recent publication that this and the complete bibliography are omitted. The histology is well presented in his other articles.

---

[1] A study from the Department of Pathology of the College of Physicians and Surgeons, Columbia University, New York.

These so-called hæmolymph nodes have been found by various observers in man, monkey, ox, sheep, goat, horse, pig, dog, cat, weasel, ferret, stoat, rabbit, squirrel, rat, mouse, bat, water-vole, mole, fowl, and turkey.

The structures denominated hæmolymph nodes vary in size from that of a pinhead to that of a lymph node, though averaging smaller than the latter. They are dark red, brown, or mottled red and white, usually smooth, soft, and elastic, but easily ruptured. Few or many bloodvessels surround or enter the nodes, in some cases at a hilum. Lymphatics are apparently absent in some cases. When ruptured the nodes resemble a blood clot. Each node possesses a delicate capsule of connective tissue with some non-striated muscle fibre. Just within the capsule is a peripheral blood sinus from which irregular prolongations run throughout the node. Between the sinuses are cords of lymphoid tissue, and usually cell collections resembling lymph follicles toward the periphery of the node. In some cases the division into cortical and medullary portions is very indistinct, and the relative amount of lymphoid tissue is generally smaller than in a lymph node. The sinuses are traversed by an irregular reticulum, usually finer than that of a lymph node, this and the sinus walls apparently being lined with endothelium. Proliferation of the endothelium appears to furnish the large phagocytes lying in the sinuses and in some cases nearly filling them. An artery enters at and a vein emerges from the hilum. The artery divides into branches which run in trabeculæ extending from the capsule through the sinuses. The finer branches sometimes appear to terminate in the sinuses; others break up into capillaries in the lymph cords, some of these capillaries apparently emptying into the sinuses. The sinuses terminate in veins which unite into one, emerging at the hilum. In some nodes small arteries enter at various points in the capsule, and in the transition forms afferent lymphatics may be seen entering the peripheral sinus. In some transition cases the blood and lymph sinuses seem to be separate systems; in others bloodvessels and lymphatics appear to mingle their contents in common sinuses. The sinuses contain varying numbers of red cells, either free or in various stages of disintegration within the phagocytic cells already mentioned, and leukocytes. The characteristic feature is said to be the occurrence normally, in the sinuses of a node, of destruction of red cells which have been brought to the node by bloodvessels.

The various interpretations which have been placed upon the presence of red blood cells within the sinuses of structures resembling lymph nodes, or the occurrence of bodies macroscopically suggesting accessory spleens or red or mottled lymph nodes, are that they are: (1) neoplasms; (2) masses of newly formed splenic tissue; (3) lymph nodes engaged in the formation of new red cells; (4) lymph nodes whose sinuses contain blood as the result of congestion, hemorrhage, diapedesis, absorption of extravasated blood, etc.; (5) hæmolymph nodes.

The interpretation as neoplasms was advanced by but one observer, Mosler, who described the dark-red nodules found in the greater and lesser omenta of a splenectomized dog and termed them "hemorrhagic telangiectatic lymphomata." Their microscopic structure was the same as that described by others as hæmolymph nodes. Tizzoni and others have interpreted them as newly formed splenic tissue, basing their view upon their occurrence in animals the spleens of which they had removed. The investigations of Morandi and Sisto, and of Warthin appear to have conclusively disproved the splenic nature of these nodules. The idea that the lymphoid nodules with sinuses containing red cells were structures engaged in the formation of red blood corpuscles has been supported by a number of the earlier observers, but recently by Retterer only. Some were led to this belief by finding in the sinuses large cells containing what appeared to be red blood cells, some of which they described as being extruded. These are now generally regarded as endothelial cells displaying phagocytic activity and ingesting the red cells. Retterer believes that lymph nodes produce blood plasma, leukocytes, and red cells, the last derived from lymphocytes by a hæmoglobin change of the nucleus. The evidence of all other investigators appears to disprove this construction of the presence of red cells. The view that the appearance of red cells in the sinuses is due to hyperæmia, hemorrhage, diapedesis, or the absorption of extravasated blood by normal lymph nodes has been advocated by several writers, of whom Saltykow is the most decided representative at present. His study of the subject has been careful and systematic. Examination of sixty autopsy cases has convinced him that the red nodes are merely lymph nodes whose sinuses contain blood brought by lymph vessels from regions in which hemorrhage has occurred, or entering them by diapedesis from capillaries in the node, or by hemorrhage from them into the lymphoid tissue or sinuses, the presence of red cells in the sinuses exciting the endothelial cells of the latter to intense phagocytic activity. His reasons for assuming that the nodes are merely lymph nodes are: in a large proportion of the cases an extravasation of blood is found in the node itself or the surrounding cellular tissue; in many nodes the vasa efferentia and subcapsular sinus are the only or chief containers of red cells, giving the impression that they are filled from without; the red nodes are found in the situations of normal nodes, and all transition forms to the ordinary type exist.

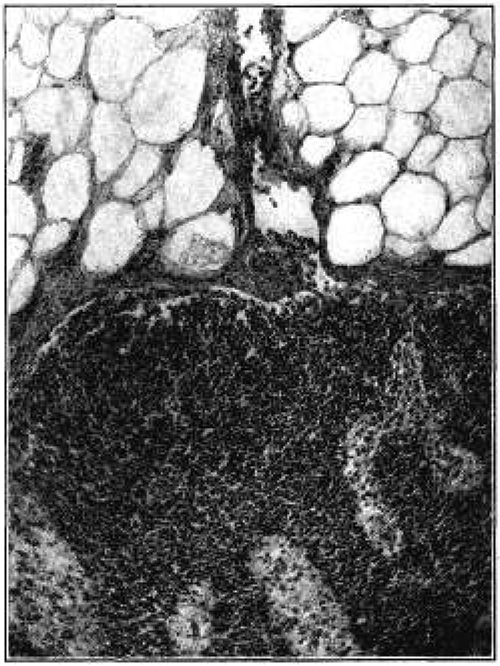
The interpretation as organs *sui generis*, variously denominated hæmolymph, hæmal, and hæmolytic nodes, dates from the time of Gibbes' preliminary report in 1884. Since the present writer began his investigations the ground has been covered with remarkable unanimity by Morandi and Sisto, Weidenreich, Lewis, and Warthin, to whose articles he would refer those desiring the bibliography, review of the literature, and full description of the histology. They agree that the hæmolymph nodes are a distinct set of organs whose functions are the production of leukocytes, and especially the destruction of red cells and to a less degree of leukocytes. Morandi and Sisto give as their reasons for ascribing to these organs a hæmolytic function the constant occurrence in their sinuses of cells containing red cells in various stages of disintegration, and the increase of those phagocytic cells after splenectomy, and still more after subsequent administration of hæmolytic substances. The writers mentioned agree also that there is a complete series of transition forms from the structure of the spleen to that of an ordinary lymph node. Warthin regards them as a set of structures subject to variation, one form passing into another as the needs of the body require. He describes the formation of new hæmolymph nodes as beginning with angiectatic dilatation of the capillaries of a fat lobule, the fat cells becoming enlarged, the capsule of the lobule thickened. Lymphocytes are infiltrated along the walls of the capillaries; fat cells are absorbed, and some are converted into reticular cells; proliferation of endothelium in the dilated capillaries divides them into blood sinuses. Continued lymphoid formation, development of sinuses, and absorption of fat complete the transition into a hæmolymph node. Progressive hyperplasia of lymphoid tissue encroaching upon the sinuses may transform this or a previously existing hæmolymph into a lymph node.

In the writer's own investigations hæmolymph nodes have been observed and studied in the adult, infant, dog, cat, red deer, rabbit, and guinea-pig. Failure to discover them in the gray squirrel was probably due to incomplete examination of a single subject.

In all experimental cases the nodes were removed immediately after death and fixed in Orth's or Zenker's fluid, alcohol, or formaldehyde solution. Celloidin was usually employed for embedding, occasionally paraffin. Hæmatoxylin and eosin were ordinarily used in staining. The experimental work was confined to the dog and rabbit, the normal condition of these animals being verified by autopsy and microscopic examination.

I. Evidence in Favor of Other Interpretations than Organs Sui Generis.

In support of the view that red cells in the sinuses are brought by afferent lymphatics from regions in which there is extravasation of blood is the fact that in a number of cases in which the sinuses of nodes contained red cells large numbers were seen in surrounding lymph spaces. This is not at all conclusive, as similar collections of red cells were found in the lymph spaces surrounding nodes whose sinuses showed no characteristics of hæmolymph nodes. In several cases nodes containing red cells were observed in which afferent lymphatics were filled more or less completely with red cells. In these the appearances of a hæmolymph node were present, yet there was distinct proof that red cells were being brought by lymph vessels. An example is shown in the accompanying figure.



Lymph node, showing red blood cells in sinuses and in afferent lymphatic.

This is reproduced from a photomicrograph of an axillary node removed during an amputation of the breast for carcinoma. In this case there was obviously extravasation of blood in the region whose lymphatics were tributary to the node. Several other such instances were found. The fact that in some instances red cells are brought to a node by afferent lymphatics does not prove that this is the invariable explanation of their presence. In a red deer examined a few minutes after death, immediately following a wound with comminution of the pelvic bones and extensive laceration of the adjacent soft parts, large numbers of small dark-red nodes were found in the prevertebral region of the abdomen and thorax and along the renal vessels. The peripheral and central sinuses of these nodes contained many red cells but no evidence of recent or former phagocytosis, while in places where the sinuses were completely filled with red cells the adjacent lymphoid tissue was also so densely packed with red cells as to suggest a local hemorrhage. The blood-vessels of the nodes were greatly congested. There were no hemorrhages in the neighboring tissues. While these nodes were so extensively distributed as to suggest that local extravasation of blood could not have been responsible for their appearance, the complete absence of phagocytosis in all examined would suggest that the red cells had entered the sinuses only shortly before fixation of the tissues. The presence of hemorrhages in the lymphoid tissue would also favor the view that these were ordinary lymph nodes with recent hemorrhages into the lymphoid tissue and thence into the sinuses, caused probably by great disturbance of the circulatory system incident to the traumatism and shock.

With a view to determining the possible influence of circulatory disturbances in producing appearances which might be described as hæmolymph nodes, the following experiment was carried out: A rabbit was anæsthetized with ether and the inferior vena cava ligated in two places, just above and below the left renal vein. The animal was found dead in the morning, about twenty hours later. Viscera normal, except great congestion of the left kidney and spleen. In contrast to the negative results obtained in previous examinations for nodes containing red cells in normal rabbits, red corpuscles were discovered in six of the nodes studied.

That circulatory disturbances will not, however, always cause the presence of red cells in lymph nodes was demonstrated by two other experiments upon rabbits. In one, ether anæsthesia, ligation of aorta, inferior vena cava, and right ureter *en masse*. Rabbit found dead next morning. Viscera normal, except congestion of kidney and desquamation of cells of its tubules. In spite of the intense circulatory disturbances, red cells were found in the sinuses of only three of eleven nodes, and of the positive specimens one showed hemorrhages into the lymphoid tissue and blood in adjacent lymph spaces. In another rabbit: ligation of the right femoral vessels after bleeding from the artery, under ether anæsthesia, repeating this eighteen days later with the left femoral vessels, and killing a day later by severing the medulla. General anæmia; cheesy area surrounded by consolidation in lung; other viscera practically normal. Nodes from the immediate vicinity of the former and recent operations showed no red cells in their sinuses. In one mesenteric node they were found enclosed in phagocytes; in two others pigment masses were observed in such cells.

Hæmolymph nodes were found in cases in which there was no hyperæmia.

These observations would seem to show that circulatory disturbances may cause the pressure of red cells in sinuses of nodes, but are not sufficient to account for their appearance in most cases.

That the presence of red cells in the sinuses may be caused by toxic substances within the body was shown by subcutaneous injection of ricin into a normal dog. In all of twenty-one nodes from the cervical, axillary, bronchial, retrosternal, gastric, mesenteric, retroperitoneal, and pelvic regions many red cells were found in the sinuses and in adjacent lymph spaces, with marked congestion of bloodvessels. Similar results, with marked endothelial hyperplasia in the sinuses, were obtained by ricin injection into a rabbit. While these experiments demonstrate that a poison in the circulation may induce the presence of red cells in the sinuses of lymph nodes the toxic action was too severe to draw strict inferences in regard to the behavior of nodes under comparatively normal circumstances.

In three dogs examined, into the peritoneal cavities of which 1 per cent. solution of zinc chloride had been injected for experimental purposes, the abdominal cavities were found post-mortem to contain bloody exudate. In one animal red cells were found in the sinuses of eleven out of fifteen mesenteric and prevertebral nodes; in a second dog, red cells in sinuses of six out of eight nodes from the anterior mediastinum; in the third, red cells or their remains free or in phagocytes in all but two of twenty-seven nodes from the prevertebral, renal, mesenteric and anterior mediastinal regions. In some cases the adjacent lymph spaces contained red cells. The red corpuscles in these nodes were evidently brought by afferent lymphatics, although none of the sections studied showed their entrance, since at various points in their circumference the peripheral sinuses were closely packed with red cells, and communicating portions of the sinuses contained phagocytes filled with red cells and some red cells free, while toward the centre of the node phagocytosis was just beginning, and since adjacent lymph spaces were filled with red cells. It is unlikely that all of the nodes containing red cells were hæmolymph nodes. Probably many were lymph nodes whose endothelium was exerting phagocytic powers in response to stimulation by the toxic substance, zinc chloride, or by some substance produced by its action, perhaps by damaged red cells from the peritoneal cavity. The occurrence of red cells in many of the nodes in these cases may, therefore, have been due to absorption of extravasated blood or to the presence of a toxic substance in the blood. That the presence of toxins does not necessarily cause phagocytic destruction of red cells in the sinuses was shown by negative findings in two rabbits. One of these had been injected with the toxin of the bacillus of rabbit septicæmia (Lartigau); the other had been subjected to the influence of the toxin of tubercle bacilli.

To summarize: absorption of extravasated blood, circulatory disturbances, and toxic substances in the circulation may cause the appearance of red cells in the sinuses of lymph nodes, but there are many nodes in which this explanation is unsatisfactory.

II. Evidence in Favor of Interpretation of "Hæmolymph Nodes" as Organs Sui Generis.

1. *Constant Occurrence.* The constant occurrence of hæmolymph nodes in the dog was shown by the following experiments: Four dogs were instantly killed by dividing the medulla, two of these subsequently being found to have microscopically normal viscera, two chronic diffuse nephritis and associated cardiac lesions; one by bleeding while chloroformed, viscera microscopically normal; one by chloroform alone; three by intravenous injections of staining fluid or pigment in suspension, viscera normal, except congestion. In each of three cases a number of hæmolymph nodes were found. The occurrence of all stages of phagocytic destruction of red cells in the sinuses in normal animals killed without unnecessary traumatism, and the nodes of which were hardened within a few minutes after death, shows that this presence of red cells in the sinuses and this blood destruction were not the result of the manipulations or a pathological condition but evidence of the performance of a normal function of the nodes. In one guinea-pig killed by chloroform a hæmolymph node was found, showing red cell destruction by phagocytes. In two of three cats examined after killing with chloroform nodes were obtained, the sinuses of which contained red cells free and in phagocytes. Although red cells were found in lymph spaces in fat surrounding the nodes, there was no reason for attributing the presence of red cells in the sinuses to pathological conditions caused by killing with chloroform, or by rupture of bloodvessels while struggling, since some of these cells were already within phagocytes. In three normal rabbits, two with cholecystitis from bacterial injection, two injected with bacterial toxines, and one splenectomized and subsequently immunized to bullock's blood, red cells were not found in the sinuses, though others have detected them in rabbits, but pigment masses were observed in some phagocytes in sinuses. In human subjects nodes containing red cells were discovered in such varied cases as infants dying from asphyxia neonatorum, gastroenteritis, status lymphaticus, and cerebral hemorrhage after forceps delivery; adults, from pneumonia, pulmonary and laryngeal tuberculosis and splenic anæmia. In a number of autopsy cases in which but few nodes were studied hæmolymph nodes were not found.

2. *Intimate Association with Ordinary Lymph Nodes.* The nodes whose sinuses contain red cells are often closely connected with ordinary lymph nodes. In one normal dog examined two nodes

were found so closely approximated as to be separated by only a few connective-tissue fibres, except at the point where blood and lymph vessels were situated. The circulatory relations could not be exactly determined. One was a typical lymph node with fine reticulum and no red cells in its sinuses; the other possessed a coarser reticulum and its sinuses contained many red cells. The two nodes were so closely connected that if the presence in the blood of some substance stimulating lymph nodes to accomplish the destruction of red blood cells was the cause of the one assuming the appearance described as that of a hæmolymph node, it would seem certain that the same influence would have acted upon the other node. On the contrary, the general appearance of the two nodes was so different and the distribution of red cells in one so distinctly marked that it would appear there was a fundamental difference in their structure and circulatory connections.

3. *Circulatory Relations.* The most direct evidence of the existence of hæmolyph nodes as organs *sui generis* would seem to be the demonstration of bloodvessels directly entering the sinuses, though it is possible that diapedesis may be responsible in some cases for the presence of red cells in them. In both dog and man I have been able to discover what appeared to be direct termination of a capillary in a sinus, but the possibility of artefacts in so delicate a tissue as a capillary wall or the lining of a sinus makes such ocular evidence unreliable. Many hæmolymph nodes appear to be more vascular than lymph nodes. The interstitial injections which have been employed by others seem unreliable, as the needle may pass into either a lymph or a blood sinus, or both, so that both systems may be injected, rendering differentiation uncertain. Two attempts to make a physiological injection of dogs through the femoral vein failed, one because the insoluble substance suspended caused embolism, the other because of the diffusibility of the material employed. In a third case insoluble Berlin blue suspended in normal salt solution warmed to body temperature was slowly injected into the proximal stump of a divided femoral vein of an anæsthetized dog, while bleeding was permitted from the distal stump in order to prevent undue increase of blood pressure. After ten or fifteen minutes of such injection the animal died. The pericardial, thoracic, and abdominal cavities were at once injected with 5 per cent. formaldehyde solution to fix the tissue cells, and the body placed in cold storage for thirty-six hours. All organs normal. In twelve of twenty-five nodes examined red cells were discovered in the sinuses. In only three was the Berlin blue found in the sinuses with the red cells, but in these three at least the coincident presence in sinuses of the recently injected pigment, together with fresh red cells not in phagocytes, would strongly point to a direct communication between the circulatory system and the sinuses of the nodes.

4. *Histological Differentiation.* The greater coarseness of the reticulum of hæmolymph nodes as compared with that of lymph nodes has been confirmed by the present study, as has the lack of differentiation between cortical and medullary regions in typical hæmolymph nodes. The frequent presence of mast cells and also of eosinophiles has been noted. The eosinophiles seem most frequent in hæmolymph nodes and in lymph nodes in cases with extreme hæmolysis such as splenic anæmia. This suggests an association between the eosinophilic granules and the destroyed red cells. Warthin's statement that phagocytes containing red and white cells are found in all sinuses of hæmolymph nodes, while in lymph nodes they are usually confined to the medullary portion, appears to be borne out.

While having no positive evidence to present in favor of the belief that transformation of fat lobules into hæmolymph or lymph nodes, or of the latter into each other, occurs, the writer has observed, in several instances, appearances which favor this view.

5. *Functions.* No evidence of red cell formation could be found. The chief function is obviously destruction of red blood cells; others are formation of leukocytes, their destruction by phagocytes, and probably formation of blood plasma. They may also be concerned in the production of eosinophiles and of phagocytes for the general circulation.

That destruction of red blood cells is an intermittently exercised function and often a purely local process, not due to hæmolytic substances in the general circulation, is shown by the occurrence simultaneously in different nodes or in different parts of the same node of its various stages. These stages are: red cells free in sinuses; apparently adherent to the periphery of the phagocytes; unchanged but contained in enlarged phagocytes; red cells disintegrating within phagocytes which are now stained more deeply red by eosin; red cells not seen, phagocytes deep reddish-yellow; phagocytes smaller, staining normally, containing granules or globules of brownish-yellow pigment; phagocytes of normal size, pigment free in sinuses.

In a node physiologically injected with Berlin blue, for example, one portion of the sinuses contained red cells which had entered long enough before to have been nearly destroyed by phagocytes, while in another portion were fresh red cells which had entered with the injected pigment immediately before death. In explanation of this intermittent action it seems most logical to believe that in some cases the bloodvessels bringing the red cells become blocked temporarily by the mass of red cells and enlarged and proliferated phagocytes in the sinuses. Blood pressure in the node is probably an important factor. In other cases the intermittent action is difficult to explain, but it may be due in some to the presence of hæmolytic substances in the blood plasma. These might cause changes in either blood cells or vessel walls which would lead to diapedesis into the sinuses.

CONCLUSIONS. Both histological and experimental evidence is strongly indicative of the existence of the hæmolymph node as an organ *sui generis*. In the light of our present knowledge the chief practical point, however, is to recognize the capability for phagocytic destruction of red blood cells which is possessed to a high degree by certain lymphoid structures, rather than to dwell upon the individuality of the hæmolymph node. The occurrence of transition forms from the node containing blood sinuses only to that with sinuses containing lymph alone renders a strict classification impossible. For practical purposes Warthin's grouping of all varieties under the heading of *hæmolymph nodes* appears eminently satisfactory.

To Dr. George C. Freeborn I am indebted for many valuable suggestions in connection with this investigation; to Dr. A. J. Lartigau for aid in the operative work, and to Dr. Edward Leaming for the accompanying photomicrograph.

BIBLIOGRAPHY.

Lewis. Journal of Physiology, 1902, vol. xxviii., Nos. 1 and 2.
Morandi and Sisto. Archiv. per le Sci. Med., 1901, vol. xxv., No. 13.
Retterer. Comptes Rendus de la Soc. de Biol., 1902, T. liv., p. 33.
Saltykow. Zeit. für Heilkunde. Abtheil für Path. Anat., 1900, S. 301.
Warthin. Journal of the Boston Society of the Medical Sciences, vol. v. p. 415.
Warthin. Journal of Medical Research, 1902, vol. ii. p. 435.
Warthin. THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, October, 1902.
Warthin. Transactions of the Chicago Pathological Society, November, 1902, vol. v., No. 8.
Weidenreich. Anatom. Anzeiger, 1902, Ergänzungsheft, Bd. xxi., S. 47.

SYPHILITIC AFFECTIONS OF THE SKIN AND OSSEOUS SYSTEM IN THE NEWBORN.

BY W. REYNOLDS WILSON, M.D.,
OF PHILADELPHIA.

SYPHILITIC infection may be transmitted in varying degrees of intensity. Its manifestations follow certain definite rules. Every newborn infant, the victim of transmitted syphilis, may not necessarily exhibit the taint; on the other hand, in the largest number of conceptions occurring in the earlier stages of syphilis transmissible from one or both parents, abortion or premature expulsion of the fetus is liable to result.

The opportunity of infection occurs:

1. In the presence of a coexistent infection in both parents. This usually results in abortion (Baginsky), although Neumann has recorded the birth of healthy infants under such conditions.